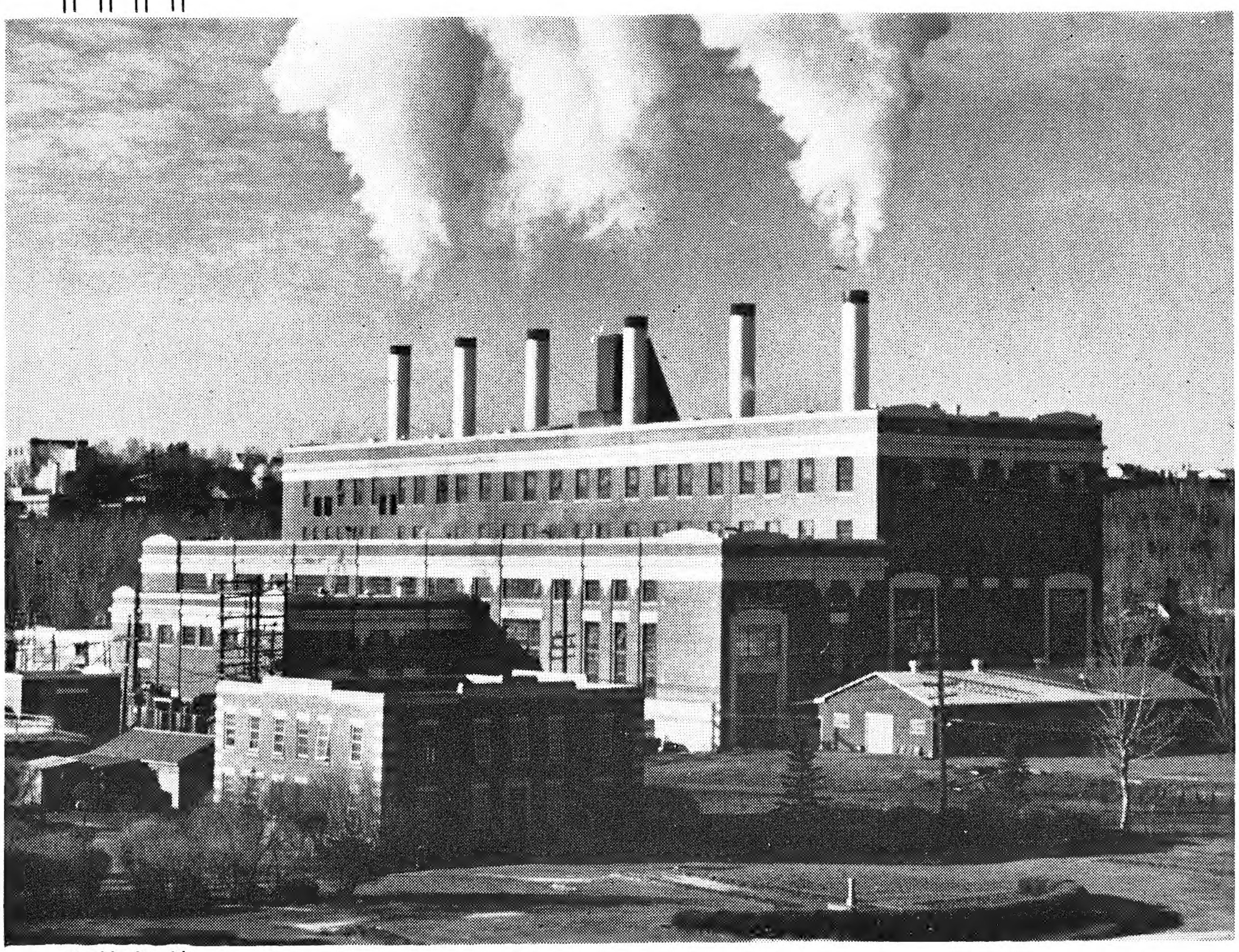
STEAM GENERATED POWER

FOR THE

CITY OF EDMONTON



POWER PLANT

CITY OF EDMONTON

POWER PLANT DEPARTMENT

THIS IS YOUR POWER PLANT

The history of the Municipal Power Plant in Edmonton is a comparatively short one but it reflects in a most striking way the changes that have taken place since the first electric light was switched on in the little community that was to become in a few years one of the most rapidly growing cities in Canada.

This history takes us back to the year 1891 when a few of the pioneers decided to keep abreast of the times and installed a very small plant near the river on what is now 101st Street. This establishment remained in private hands until 1904 at which time the plant was taken over and operated as a municipal enterprise.

In the years that followed the population kept on increasing to such an extent that it soon became evident that the site of the existing plant would not accommodate the size of plant which the engineers of that day foresaw. They decided to start afresh on a new site and in 1907 the first installation was made on the present site.

Before the First World War Edmonton was experiencing a tremendous boom and as a result preparations were made and some contracts let for a new up-to-date plant in the same vicinity. However, the war came along and all thoughts of extension were dropped. In 1916 the Alliance Power Company took over the operation of the plant and controlled it until late in 1919 when the City again took over the plant.

There have always been citizens who realize that municipal ownership of utilities can be a distinct asset when under competent management and these citizens held the fort on many occasions in the past. The result of this faith can be seen in the large and efficient plant which now furnishes the City with light and power.

There have been several highlights in the history of the Plant which are worth recording. Among these may be mentioned the using of slack or small size coal on chain grate stokers. This size of coal in the early days was a waste product and the mines were glad to get rid of it. As the years went on the larger consumers of coal in the City started following our example and a market was established for this one time waste product.

In 1927 the Power Plant purchased and put into operation a 10,000 KW Parsons Turbine operating at 3600 rpm. This was the largest unit then built anywhere to operate at this speed and it turned out to be a most efficient and dependable machine. When the time came during the modernization of the Plant that this machine had to be removed it was sold and is now in operation in the City of Prince Albert, Saskatchewan.

Around 1929 it was foreseen that the pressure and temperature at which the plant was operating were no longer in line with the latest developments and considerable engineering study was undertaken to decide what would be the most efficient and economical operating conditions for the ultimate development of the plant on this site.

The final decision was that a start be made at once on the first unit of a plant which would have an ultimate capacity of 90,000 KW and would operate at 400# pressure and at a temperature of 750°F. The plant reached this capacity in 1953 and we are at present adding another 30,000 KW bringing the capacity of the plant to 120,000KW. When the ultimate capacity was being discussed and established there was no evidence of oil at Leduc, Redwater and Drayton Valley so that the tremendous impetus given to the City's growth by these discoveries forced us to add this additional 30,000 KW to tide us over until a new plant was designed and put in operation.

Since 1930 various agreements have been signed with Calgary Power Company for the sale and interchange of power, and for standby purposes. Considerable energy was sold to Calgary Power Company during 1940-45 to help operate the war industries on their system.

Ever since 1931 when the first section of the old plant was demolished to make way for the more modern equipment it has been necessary to keep the plant in full operation. With the installation of #4 Turbine and #6 Boiler at the north end of the plant all traces of the original plant have disappeared.

The Plant, when the present extension is completed, will have a generating capacity of 120,000 KW and a steam generating capacity of 1,390,000 pounds of steam per hour. These totals are made up as follows:—

2 coal-fired boilers rated at	155,000 lb/hr. each
1 gas-fired boiler rated at	150,000 lb/hr. each
3 gas-fired boilers rated at	200,000 lb/hr. each
1 gas-fired boiler rated at	330,000 lb/hr. each
(All gas-fired boilers are equipped to burn oil in case of emergency.)	
2 Turbo-generators rated at	15,000 KW each
3 Turbo-generators rated at	30,000 KW each

It will be of interest to note the increase of energy sold to the City Departments. These Departments comprise the Electric Light and Power Department which takes care of all distribution outside of the Power Plant; the Transit System which operates the transportation system, and the Pumping Plant which delivers treated water to the Waterworks Distribution System. The following tabulation gives the totals sold at 5-year intervals ending with 1953 as the last complete year:—

YEAR	K.W.H. SOLD TO CITY DEPARTMENTS	INCREASE %
1928	42,331,400	
1933	50,206,700	18.6
1938	63,532,700	26.6
1943	104,392,900	64.0
1948	149,756,100	43.5
1953	271,032,800	81.0

It is estimated that for the year 1954 we will sell to City Departments about 316,500,000 KWH—an increase over 1953 of 16.8%. It is to be noted that sales are doubling every seven years.

The above figures show very clearly that the problem of providing generating capacity sufficient to take care of the city's requirements is one that is constantly with us. So far in the history of the Plant the capacity has always been sufficient for the load imposed on it but at times the margin has been very narrow. When one considers the most exceptional increase in population and electrical load following the discovery of oil we must consider ourselves as being extremely fortunate in being able to keep ahead or merely to break even with the demands on the Plant.

It is with such a background and a careful analysis of all factors that the decision was reached to proceed with the design and engineering of a new modern plant to be situated immediately west of the present plant. The first installation will consist of a Circulating Water Pumping Station which will be built during the 1954-55 winter. This station will be connected through 3 - 60" pipes to an intake situated about 120 feet out in the river. This station will

eventually have a pumping capacity of 200,000 gallons per minute and will take care of the new Power Station and the enlarged Water Treatment Plant.

This new Power Plant will eventually contain 60,000 KW turbo-generators and three gas-fired boilers. The first installation will consist of one turbine and one boiler with auxiliary equipment. The unit will operate with steam at a pressure of 850 pounds per square inch and a temperature of 900°F and should be in operation for the winter of 1958-59.

From the above brief story one can trace the growth through fifty years of the Power Plant Department. The original plant back in 1891 probably supplied energy for a few carbon-filament lamps and now we have a plant capable of lighting 2,000,000 — 60 watt lamps with still larger capabilities in the near future. All who have participated in designing, building and operating your Power Plant are extremely proud of their accomplishments.

PLANT LAYOUT

The Turbine Room is about 390 feet long and contains two 30,000 KW and two 15,000 KW turbines now installed with another 30,000 KW turbine on order.

At the north end is a 30,000 KW Parsons Turbo-generator with its control board on the right. The steam enters at the north or high-pressure end of the turbine and after expending part of its energy passes through the two large pipes seen above the machine to the low-pressure end and thence to the condenser which can be seen under the floor. At the south end of the generator you will see the main and pilot exciters.

In the Boiler Room are six large Babcock-Wilcox & Goldie-McCulloch boilers. The two north boilers are gas-fired, each with a steaming capacity of 200,000 pounds of steam per hour. The air pre-heaters are at the back of the boilers and the fan-room is 50 feet above the operating floor. The gas enters the furnace at the front of the boilers through a series of burners. Close to the west wall and facing the boilers are the control panels on which are various instruments recording the operating conditions of each boiler. Normally all operations are automatic with a master controller sending impulses to each individual boiler control.

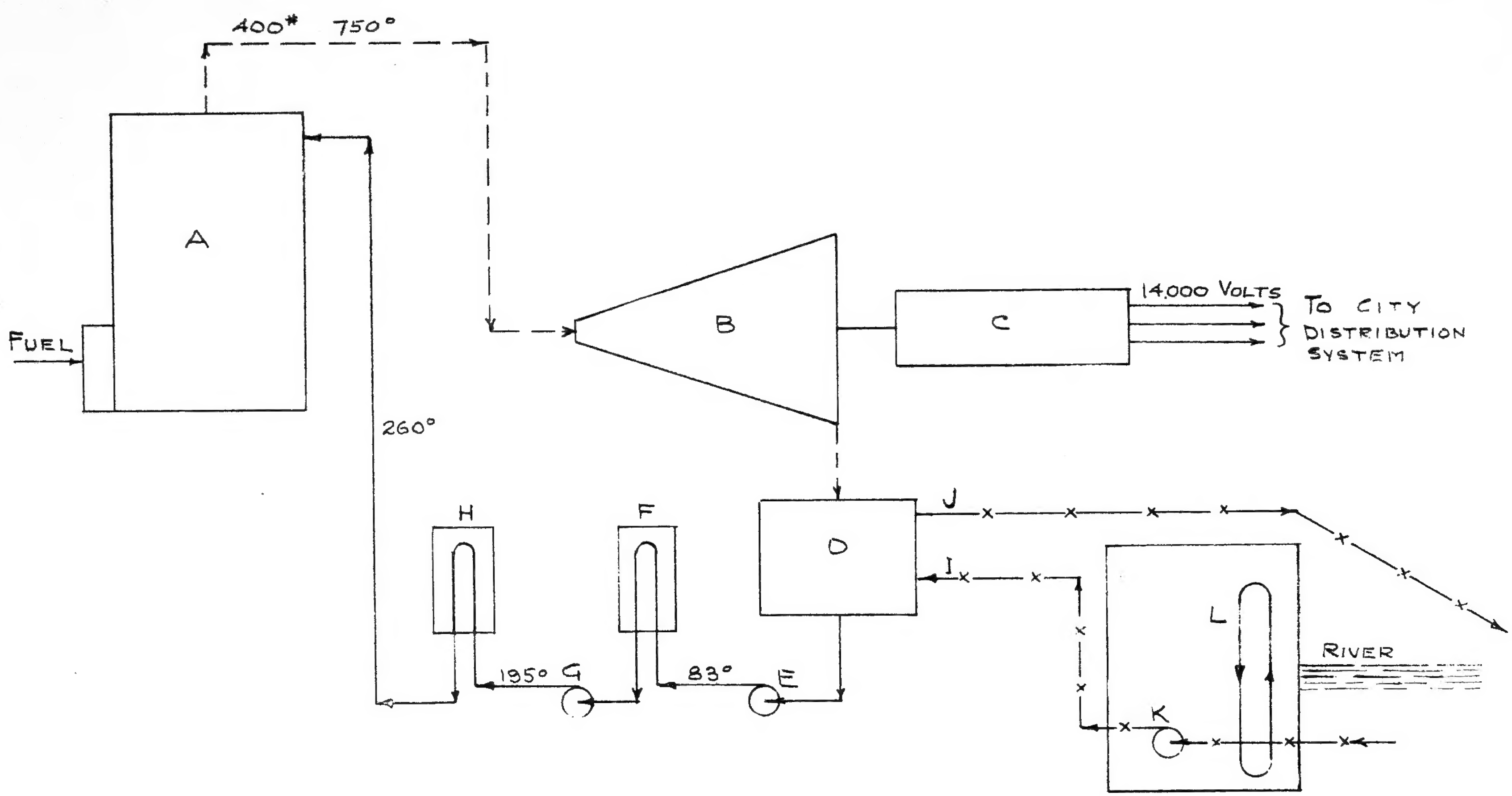
Overhead are the bunkers from which coal is fed through a weigh-lorry to the coal-fired boilers. From the boiler coal hoppers the coal is fed to the travelling grates in the furnaces. There are two coal-fired boilers. Two gas-fired boilers and one future gas-fired boiler are at the south end of the boiler room.

In the Control Room all electrical controls for generators and outgoing lines are centralized. At the north end is the Control Board for the Transit System Rectifiers and Feeders and a Console for the sub-station remote controls. In the centre is the main control panel with controls for each generator and for all feeder circuits. The operator has telephone, radio and intercommunication systems which enable him to keep in touch with all parts of the Power Plant, Office, Water Treatment Plant and the work trucks of the Electric Light Department.

Near #2 Turbine are two pumps connected to the circulating cooling water discharge pipe. These pumps deliver warm water in the wintertime to the Water Treatment Plant. The intake pipe is below the discharge pipe.

On the main floor of the Circulating Water Pumping Station are the motors driving the pumps which are located at the bottom of the building and which are below the level of the river. These pumps draw the water from the intake in the river through a 60″ line. Looking down from the operating floor the travelling screens can be seen. These screens remove all debris such as leaves, twigs, fish, etc., from the water before it is pumped to the turbine condensers.

Flow Diagram for Boiler & Turbine Installation



- A - Boiler & Furnace
- B - Turbine
- C - Generator
- D - Condenser
- E - Extract Pump
- F - Low Pressure Heater
- G - Boiler Feed Pump
- H - High Pressure Heater
- I - Circulating Water Inlet
- J - Circulating Water Outlet
- K - Circulating Water Pump
- L - Travelling Screen

— — — — Steam

———— Condensate

—x—x— Condensing Water

PLANT OPERATION

The preceding diagram shows very simply how the Power Plant operates, where gas, coal or oil and water are fed into the boiler to generate steam and electrical energy is delivered from the generator to light homes or run motors.

'A' is the boiler where water entering at a temperature of 260°F is converted to steam at a pressure of 400 pounds per square inch and at a temperature of 750°F. This steam then enters the turbine 'B' where its energy is used to drive the rotor which is connected to the rotor of the electric generator 'C'. This action generates electric energy which is sent out to the City Distribution System. The steam, in passing through the turbine 'B', gradually gives up its pressure and temperature until it finally enters the condenser 'D' at a vacuum of 1½ inches of mercury. By coming in contact with hundreds of one inch tubes through which river water is being pumped this steam is reconverted to water and is ready to start on its way back to the boiler. First of all this water is picked up by the extract pump 'E' which forces it through the low pressure heater 'F' where it picks up some heat. It then goes to the boiler feed pump 'G' which in turn sends it through the high pressure heater 'H', where it picks up more heat and then goes back to the boiler. Thus the cycle is complete and the steam which left the boiler is now back again into the boiler as water.

The heaters 'F' and 'H' contain a large number of small tubes through which the water passes. On the outside of the tubes there is steam bled from the turbine which gives up its heat to the water and is, in its turn, converted to water which eventually gets back into the system through condenser 'D'.

It is interesting to note that in 1953 the 4 gas boilers used over 3 billion cubic feet of gas and the 2 coal boilers 95,000 tons of coal.

The gas which is used comes either from the natural gas field at Kinsella or from the stripping plant at the Leduc oil field.

The coal used is all supplied from local mines and is of a grade known as sub-bituminous. This coal is passed through a crusher located above the coal bunker and is then fed into the boiler hoppers through the travelling weigh lorry. From the hopper the coal is spread on a travelling grate which travels slowly to the back of the furnace. During its progress the coal which starts off with a thickness of from 6 to 8 inches is gradually completely burned until it reaches the rear of the furnace where, in the form of ash or clinker, it drops down to the ash hopper and the grate returns empty to the front of the furnace. Gas is the principal fuel and coal is used chiefly in the winter to keep the gas demand down.

When anything is burned it is necessary to supply oxygen. As you know, the air we breathe consists principally of oxygen and nitrogen—the nitrogen in the case of combustion being a useless component. Very large quantities of air are required. As an instance, the boiler at the north end of the plant when running at full load requires 212,000 pounds of air per hour, in order to burn 298,000 cubic feet of gas per hour. As you must realize this is a lot of air and, in order to provide this air, there are forced draft fans situated above and at the back of each boiler. These fans take the air from outside the building and drive it through an air preheater to the burner boxes which can be seen in front of the gas-fired boilers or, in the case of coal-fired boilers, to several compartments situated between the upper and lower chains of the stokers.

After the gas or coal has been burned and most of its heat transferred to the water or steam in the boiler the products of combustion have to be removed. This is done by means of induced draft fans which draw the gases through the air preheater where some of the heat in the gases is transferred to the incoming air. These induced draft fans discharge the gases to the atmosphere through the stacks on the roof of the plant.

If you will refer back to the diagram you will note the circulating water inlet 'I' and outlet 'J' at condenser 'D'. This water is pumped from the river through the condensers and is then returned to the river after fulfilling its purpose of converting the steam in the condensers to water. This water, as it comes from the condensers, has picked up some heat and during the winter some of this water is pumped over to the Water Treatment Plant in order to facilitate the chemical action of the softening agents and also to prevent the freezing of the basins.